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Fig. 40. *Lacerta ocellata* Daud. ; nat. size.
41. *Tupinambis teguexin* Daud.; nat. size; from Cuvier.
42. *Cnemidophorus tessellatus* Say ; × 2.
43. *Anniella pulchra* Gray ; × 4 ; from specimen from James S. Lippincott.
44. *Chirotes canaliculatus* Bonn., × 4.
45. *Amphisbœna alba* Linn.; $\frac{3}{5}$ nat. size.
46. *Rhineura floridana* Baird ; × 4.

Lettering.—*Gh.*, glossohyal ; *Bh.*, basihyal ; *Hh.*, hypohyal ; *Ch.*, ceratohyal ; *CB. I*, first ceratobranchial ; *CB. II*, second ceratobranchial ; *EB.*, epibranchial ; *St.*, stapes ; *E. St*, epistapedial ; *S. St.*, suprastapedial.

ERRATA.

Page 211, line 16, for 41 read 37.

Page 211, line 27, for Plate v, Fig. 26, read Plate vi, Fig. 38.

Page 216, lines 25-30. This description of the pelvis of Anniella is erroneous. I describe it in a paper in press in the *American Journal of Morphology*, and not having the MS. with me when the present paper was written, trusted to memory, and confused it with the pelvis of Feylinia.

On Some New and Little Known Paleozoic Vertebrates.

By E. D. Cope.

(*Read before the American Philosophical Society, April 1, 1892.*)

It has been long known that the Catskill-Chemung beds of Northern Pennsylvania contain a fish bed rich in specimens. This deposit has been traced from Warren, on the west, to Susquehanna county, inclusive, on the east. It is now known that at the close of the Chemung epoch, as at the close of the Devonian in Belgium and Scotland, land emergences took place, producing more or less continued brackish and fresh-water conditions. The latter received the deposits known as the Catskill in the Eastern United States, and their alternations with Chemung beds containing Chemung invertebrate fossils are now well established as facts of our geological history. A recent visit to Tioga and Bradford counties, in Pennsylvania, has recently afforded me the opportunity of inspecting some of the localities where vertebrate fossils occur. These have been already referred to by Prof. J. S. Newberry in his work on the Paleozoic fishes of North America. Guided by two geologists residing in the regions in question—Mr. Andrew Sherwin, of Mansfield, Tioga county, and Mr. A. T. Lilley, of Leroy, Bradford county—I had an excellent opportunity of observing the mode of occurrence of the fossils and of obtaining specimens. I wish here to express my particular indebtedness to these gentlemen for the aid they have rendered me.

The locality I visited, near Mansfield, is typical Catskill. The list of species obtained is not large. They are :

Bothriolepis nitidus Leidy. *Holonema rugosum* Clayp. *Ganorhynchus* *oblongus*, sp. nov. *Osteolepis* or *Megalichthys*, fragments. *Holoptychius americanus* Leidy. *Holoptychius giganteus* Agass.

From Chemung beds near Leroy I obtained :

Holonema rugosum Clayp. *Holonema horridum*, sp. nov. *Holoptychius filosus*, sp. nov.

From another locality, probably Chemung, near Leroy :

Bothriolepis minor Newb. *Coccosteus macromus*, sp. nov. *Osteolepis* or *Megalichthys*, fragments.

At the last-named locality the specimens are very abundant, but mostly dissociated, so that it is rarely that two pieces of the same fish are found in their natural relations. The bed where they occur is in some places carbonaceous from the abundant organic matter deposited there. Fragments of the Osteolepid fish above referred to are abundant, but they are too scattered for identification.

To the species found in Pennsylvania, I add the description of a fine Megalichthys from the Carbonic of Kansas.

OSTRACOPHORI.

HOLONEMA HORRIDUM, sp. nov.

This large species is represented by the nearly perfect mold of a plate whose position may be determined by the following considerations. It has almost exactly the form of the lateral plate of the specimen of the *Holonema rugosum* Clayp., to which I referred in describing the supposed pectoral spine of that species.* From the fact that the specimen referred to presents two median scuta, I have supposed that it is a part of the carapace. It is, however, true that the exposed surface of the long anterior median plate is acuminate in front, showing that the anterior lateral plates join anterior to it. This is not known to occur in the carapace, but is characteristic of the plastron. That this conclusion is correct is shown by the character of the median posterior scute of *H. rugosum*, shortly to be described. This being the case, it is necessary to admit that there are two median scuta, a character thus far unknown in the Antiarcha, and one which distinguishes the genus Holonema from Bothriolepis.

On this interpretation, the scute to be described is the posterior lateral of the left side of the plastron. It is about three-fifths the size of that of the *Holonema rugosum* and is considerably longer than that of the *Bothriolepis nitidus* Leidy. It differs from both species in its superficial sculpture. In the last-named species this is generally concentric to a non-central point. In the *Holonema rugosum* the sculpture radiates from a more or less central point. In the present species the pattern is longitudinal from end to end of the plate. The anterior part of the external border of the plate is present in the rock mold, so that a cast of its surface was not obtained ; but, with this exception, the cast is nearly complete. On the middle of the plate, commencing at the anterior extremity, the ridges are least interrupted. Anteriorly they are oblique or slightly imbricate, looking outwards, and are connected at longer intervals ; near the inner border, but little connected. Posteriorly they are more direct and are more frequently joined by transverse connecting ridges. Near the middle of the external region the ridges so inosculate as to produce a non-linear arrangement of round pits. On the inner side of the plate the sculpture is finer and is longitudinally honeycombed.

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* Proceedings U. S. Natl. Museum, 1891, p. 456.

	MM.
Total length of plate	120
Width at middle	60
Length of anterior internal border	90
Length of posterior internal border	47

In the roughness of its surface this species exceeds those that are known to belong to the Antiarcha.

Chemung bed, Bradford county, Pa., A. T. Lilley.

HOLONEMA RUGOSA Clayp.

Newberry Paleozoic Fishes of N. Amer., 1889, p. 92.

Pterichthys rugosus Claypole, Proceeds. Amer. Philosophical Soc., 1883, p. 664.

Fragments of the exoskeleton of this species are common in the Chemung beds, and they are generally of large size, much exceeding that of any other species of the Bothriolepididæ. They are generally so much broken as to render their location difficult. I obtained from Mr. Lilley a number of fragments of such a plate, which, on reconstruction, proves to belong to the posterior median dorsal plate, enough of which remains to give a good idea of its form and sculpture. The anterior margin only is entirely wanting.

The plate is obtusely rounded at the median line, giving an obtusely roof-shaped form. It is relatively rather narrow anteriorly, and widens gradually to the posterior border, where it is also flatter. The edges (lateral and posterior) are rather thin, and the lateral are obscurely beveled below, as though to overlap the lateral posterior plates. The middle line below is openly grooved on the anterior half, while a longitudinal thickening marks the middle line of the posterior fourth below. The inferior surface is smooth, while the superior surface is sculptured with the parallel grooves characteristic of the species. These grooves extend to the lateral and posterior borders. The median ones are longitudinal and without interruption throughout the length of the fragment. Those on each side of the middle line diverge slightly and reach the margin, the lateral at an acute angle as far forward as the middle of the length of the fragment. From this point forward they diverge in a direction gradually approaching and thus reaching a right angle with the margin. The transverse grooves form a band which increases in width anteriorly until it is nearly one-third the width of the plate in front. The grooves are fine and are separated by interspaces wider than themselves. They become coarser anteriorly, the interspaces measuring 1.5 mm. ; posteriorly they measure 1 mm.

The middle line above shows some unsymmetrical low tuberosities which do not correspond to cavities on the inferior side. The plate is generally thin.

Measurements.

	MM.
Length of fragment	222
Width of plate at front of fragment	110
Thickness of plate at front of fragment	5
Width of plate at posterior border	120

This piece, together with the pectoral limb which I have already described, demonstrates the position of the genus to be with the Antiarcha, and not with the Arthrodira, as has been suspected by Mr. A. S. Woodward.

Chemung, Bradford county, Pa., A. T. Lilley.

BOTHRIOLEPIS MINOR Newb.

Paleozoic Fishes of North America, 1889, p. 112 ; Pl. xx, Figs. 6–8.

Fragments of this species are exceedingly abundant in the Chemung rocks in Bradford county, but generally dissociated. The examination of a large number of these demonstrates the correctness of the generic references made by Prof. Newberry. The most abundant pieces are the lateral ventral plates, the anterior median dorsal plate, and the median occipital. The latter sometimes remains in conjunction with the plates on either side of it.

These specimens are unaccompanied by any trace of scales or fins, thus agreeing with other species of the genus. There is also but one median abdominal plate, showing that the *B. minor* is not to be referred to Holonema. One of the characters of the species is seen in the fact that the sensory grooves of the median occipital plate do not extend to the smooth articular border, but are separated from it by a band of sculpture. The premedian plate is crossed by a groove which presents an abrupt loop backwards at the middle. The species always remains much smaller than the *B. nitidus* Leidy (*B. leidyi* Newb.).

Leroy, Bradford county, Pa., A. T. Lilley.

DIPNOI.

GANORHYNCHUS OBLONGUS, sp. nov.

Established on what is either the symphyseal element of a mandible, or a median bone of the superior mouth-arch. It consists of an oblong trough-shaped plate with a thickened, somewhat revolute border, which is concave in two directions ; that is, in the direction of the concavity of the trough, and as a concavity of its free margin. This form indicates that it occupied an oblique position, like the elements mentioned, so that the thickened surface should fit closely the corresponding elements of the opposite jaw. There is no enamel covering the masticatory border, but this may have scaled off. There are no lateral denticles as in the Holodus of Pander. As compared with the *G. beecherii* of Newberry, this bone has the length relatively much greater as compared with the width. The width in that species exceeds the length several times, while in the *G. oblongus* the width but slightly exceeds the length. The concavity of the masticating border is greater ; the size is very much less. As compared with the *G. woodwardii* Traqu., this species is very much smaller ; there are no "nareal" notches ; and no tubercles on the edge.

The sides of the body of the bone are nearly parallel, and the posterior border is gently convex. Two layers are visible ; the interior one, like the external, has a coarsely punctate surface.

		MM.
Length	at middle	9
	at border	10.5
Width	at proximal extremity	8.5
	at masticatory extremity	13.5

From near Mansfield, Tioga county, Pa.; from the Catskill formation. From Andrew Sherwin.

TELEOSTOMATA.

COCCOSTEUS MACROMUS, sp. nov.

Fragments of this species are abundant in the Chemung rocks at Leroy, and I select as typical of it a pair of supraclavicular and adjacent pieces, which display its characters best. The supraclavicle has lost the condylar articulation. Both extremities display the unsculptured surface, and the usual groove extends obliquely across the sculptured portion at about two-fifths the length from one of the extremities. The sculpture consists of obtuse tubercles with delicate radiate-grooved bases, which are usually separated by spaces equal to their own diameters, sometimes by narrower spaces, but never by spaces which are wider. At some points they have a linear arrangement. This sculpture is coarser than in the *C. americanus* Newberry (see the Paleozoic Fishes of North America, by this author), but resembles that of the *C. decipiens* Agass. of Scotland. From this species the *C. macromus* differs in the elongate form of the supraclavicle, which is relatively short and wide in the *C. decipiens* (see Agassiz, in the Poissons de la Vieux Gres Rouge, and Zittel, Handbuch der Paleontologie).

	MM.
Length of supraclavicle	35
Width just above condyle	16

Associated and in contact with these pieces are two acuminate oval bones which may be opercula. Each is pierced by a groove. They display the inferior side, which is smooth.

MEGALICHTHYS MACROPOMUS, sp. nov.

Established on the greater part of an individual from the Carbonic system of Kansas. With the exception of a short interval just behind the head, the specimen is complete as to its length ; the pectoral and ventral fins are damaged, and the extremity of the anal is broken off. The scales of one side of the body only are visible in the present state of the specimen, and a good many of those of the abdominal region are lost.

The general characters may be enumerated as follows : The form is slender. The scales are large and rhombic, with rounded extremities. The supratemporal (cheek) bones and opercula are very large, and are much extended posteriorly. The enamel is present on the superior aspect of the skull in small and irregular patches only, but it covers the rest of the external surfaces. It is everywhere closely and minutely impressed-punctate. The bones of the skull are thin and light.

The elements of the skull are distinguishable for the most part, the sutures being obliterated on the nasal region. The pterotics (squamosals Traquair) are longer than the postfrontals, and the parietals are longer than the frontals. The supratemporals (cheek-bones Traqu.) are very large, extending posterior to the posterior border of the parietals. The intercalaria are large (supratemporals Traqu.). The opercula are very large, and in this specimen they are shoved upwards so as to overlap at the median line. Their length enters the total length of the skull, three and a half times, and is a little greater than that of the parietal bones. Their superior margin is leveled off from a low longitudinal thickening, from which some low wrinkles radiate downwards. Enamel is present on the superior surface of the skull, on the border of the frontal bone posterior to the orbit, and on the anterior part of the postfrontal bone. There are grains of enamel scattered on the parietals. On the supratemporals there are closely placed concentric interrupted lines on the superior part, and irregular patches of larger size on the inferior part. There are large patches of enamel on the opercula. The superior bones of the skull are everywhere roughened with minute tuberosities, which fuse into transverse ridges on each side of the sagittal suture. The maxillary bones are displayed partly on the superior, partly on the inferior faces of the specimen. They are rather slender, and their distal extremities are broken off.

There is a short pyriform symphyseal, entirely enclosed by the mandibular rami, and a median gular bone which joins the gulars with a concave suture. The gulars are large, and measure three times as long as wide at the middle. They are cut off obliquely on the inner side posteriorly, by the chevron-shaped arrangement of the pectoral scales. Several large external gulars. The posterior extremities of the mandibles are broken so that their proportions cannot be exactly ascertained, but the length preserved is six times the width opposite the anterior gular. The surface of their inferior portions is marked by coarse impressed punctures besides the usual minute ones. The former are not present on any other part of the fish.

The scales are large; between the bases of the pectoral and ventral fins can be counted about twenty-one rows, and between the ventral and the first dorsal immediately above, eight rows. The first dorsal fin is above the ventral, and the second dorsal above the anal. There are two large scales on each side which embrace the base of the first ray of the first dorsal and anal; the other fins are too imperfect at the base for description. The caudal fin is shortly heterocercal, and there are six broad fulcral scales protecting the side of its inferior border. In all the fins the rays are segmented. A half dozen rays near the border are coarse, but the remaining rays are finer. In all the fins the coarse rays are distally subdivided.

Measurements.

	MM.
Total length of specimen (20 mm. intercalated behind head)	950
Length to anterior border of orbits	45
Length to posterior border of parietals	143
Length to posterior border of operculum	230
Length to anterior base first dorsal fin	620
Width between orbits	33
Width of parietals + postfrontals anteriorly	38
Width of parietals and pterotics posteriorly	75
Length of symphyseal bone	15
Length of anterior gular	13
Length of gular	120
Length of first dorsal fin	110
Length of caudal from inferior base to superior free apex	135
Depth of body at first dorsal	85
Depth of body at second dorsal	50

This species is not nearly allied to the species from the Permian of Texas, the *M. nitidus* Cope, which is smaller and more robust in form. It has its scales and ganoine, generally, perfectly smooth, and there are but fourteen rows of scales between the pectoral and ventral fins. From the European species with punctate ganoine it differs in the longer gular bones and more elongate head, so far, at least, as concerns the *M. hibbertii* and *M. laticeps*. In *M. pygmæus* the scales are described as coarsely punctate by A. S. Woodward. Its dimensions are about equal to those of the *M. hibbertii.* The crescentic ganoine scales of the muzzle of that species and the *M. nitidus* are absent from the *M. macropoma.*

I owe the opportunity of examining the beautiful specimen which is described above to my friend, Mr. R. D. Lacoe, of Pittston, Pa., whose collection of Paleozoic fossils is so valuable, and has been of such utility to students of the subject.

(?) HOLOPTYCHIUS FILOSUS, sp. nov.

Represented by a large scale which has a peculiar and characteristic sculpture. But a small part, if any, of the proximal border is smooth. There is an area of coarse tubercles whose centre marks the proximal fourth of the long diameter, and whose vertical diameter somewhat exceeds the longitudinal. From this area there radiate in all directions to the circumference, ridges, of which the proximal are very coarse, but which become finer to the posterior side of the central area. The longer and finer ridges divide dichotomously at various points as they approach the border, the division being most conspicuous in two lines above and two below the longitudinal middle line. The ridges are quite fine and are separated by spaces rather wider than their diameter, except proximal to the area, where the reverse is the case.

This species is represented by a mold from which a cast has been made. The distal border is evidently thin, and has been more or less broken, so that its outline is not certainly known. The following longitudinal measurement may, therefore, require revision at some future time.

		MM.
Diameters of scale	longitudinal	(?)63
	vertical	65
Diameters of tubercular area	longitudinal	10
	vertical	15
Width proximal to area		9
Five distal radii in		5

It will be observed that this is the equal in dimensions of the largest species of Holoptychius known. Its sculpture serves to connect the species of the *H. nobilissimus* type with those of the group Glyptolepis. The apparent absence of proximal smooth border may be due to accident, as the border is not complete ; but it is, in any case, narrower than in the known species.

From the Chemung beds of Leroy, Bradford county, A. T. Lilley, I have, like Prof. Newberry, obtained the *H. americanus* Leidy, and the *H. giganteus* Agass., from the Catskill beds of Bradford county, Pa., through Mr. Andrew Sherwin, to whom I am under many obligations.

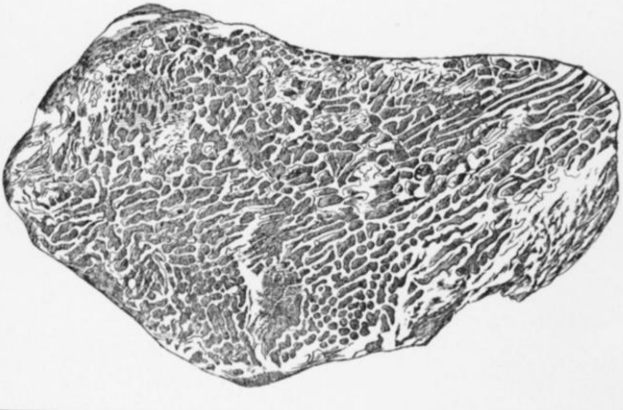


FIG I.

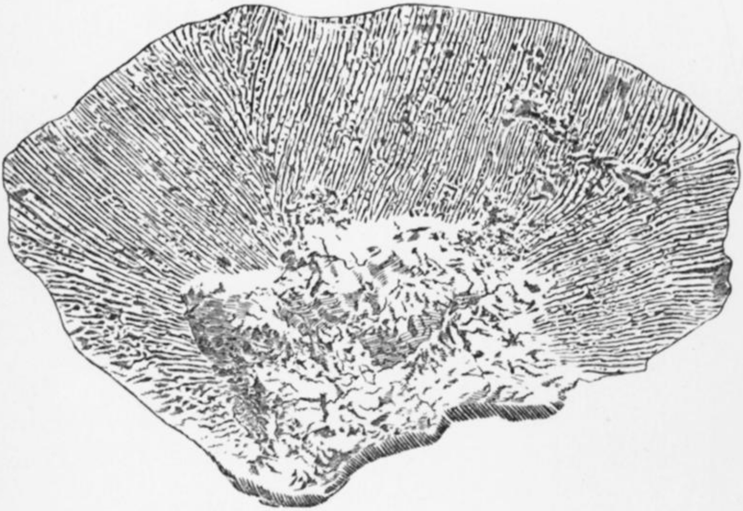


FIG.2

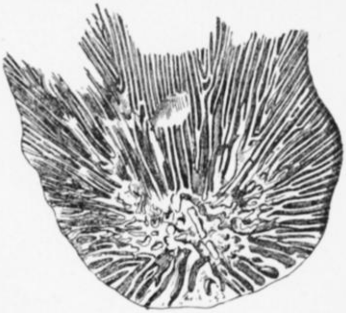
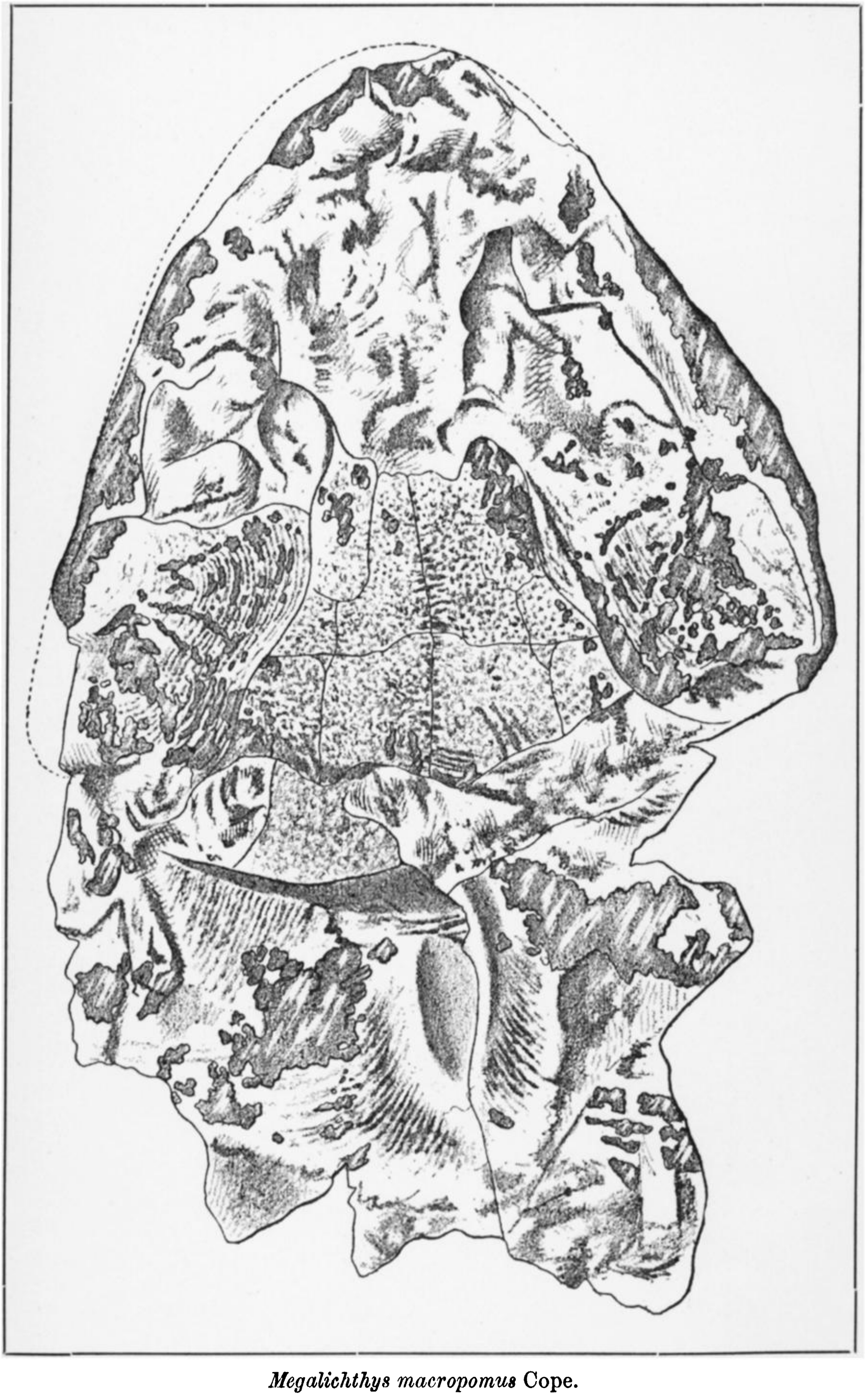


FIG 3

1. *Holonema horrida.* 2. *H. rugosa.* 3. *Holoptychius flosus.*



Megalichthys macropomus Cope.

EXPLANATION OF PLATES.

PLATE VII.

Fig. 1. *Holonema horrida* Cope ; lateral ventral plate ; two-thirds natural size.
Fig. 2. *Holonema rugosa* Claypole ; lateral ventral plate ; one-half natural size.
Fig. 3. *Holoptychius filosus* Cope ; scale ; two-thirds natural size.

PLATE VIII.

Megalichthys macropomus Cope ; skull from above ; about three-fourths natural size ; from the collection of R. D. Lacoe.

Civil and Military Photogrammetry.

By R. Meade Bache.

(Read before the American Philosophical Society, May 6, 1892.)

Photogrammetry is recognized as a legitimate mode of surveying. It is, in fact, if practiced with due regard to the limitations involved through spherical aberration from object-glasses of too wide aperture, a mode of surveying of considerable accuracy, although not for a moment to be compared to other perfected modes of the present day. It can never rival these in their sphere, which is the sphere of extreme precision, but at the same time it must be admitted that, within its own, it is capable of doing good service.

The diagram on the blackboard has been made as simple as possible, to illustrate the mode of obtaining a single vertical and a single horizontal determination. It is evident, however, that the sectors of horizon and intervening landscape belonging to each picture, assumed to have been taken from the respective stations, *A* and *B*, might be filled with objects. Many of these, from the fact of their having been visible from both stations, would be determinable by this method of cartography.

AB is a base to serve for the determination of some of the details of a survey. The optical axis of the camera being set at each station respectively upon a prominent, distant object, say a lone tree, the angle at each station between the base and that object is taken.